

Safety Evaluation by the DOE Regulatory Unit
of Proposed Authorization Basis Amendment Request,
ABAR-W375-99-00008, Rev. 0
to the Safety Requirements Document for the
Tank Waste Remediation System-Privatization Project
(Contract DE-AC06-96RL13308)

1. INTRODUCTION

The Tank Waste Remediation System-Privatization (TWRS-P) project as described in the above referenced contract consists of a facility to vitrify radioactive waste at the Hanford Site. The Safety Requirements Document (SRD) is an authorization basis document that prescribes the set of radiological, nuclear and safety standards and requirements that will be used to design, construct, and operate the vitrification facility. By letter dated September 9, 1999 as augmented by letters dated September 21, 1999 and October 8, 1999, the contractor, BNFL Inc., proposed an Authorization Basis Amendment Request (ABAR) to change standards associated with seismic criteria for the facility. Specifically, changes were proposed to SRD Safety Criteria 4.1-2, 4.1-3, 4.1-4, and 4.1-5. These criteria primarily relate to the seismic design but also address other Natural Phenomenon Hazards (NPH).

This SRD amendment request is the culmination of a comprehensive evaluation to develop seismic criteria for the TWRS-P facility. The documents and evaluations referenced herein and the seismic standards that are incorporated into the SRD by this ABAR constitute the seismic design criteria for the TWRS-P facility. The bases for these criteria are included in this evaluation and the referenced documents.

2. BACKGROUND

SRD seismic standards were initially proposed by the contractor during the standards development process associated with Part A of the TWRS-P Contract. A detailed evaluation of seismic hazards and design requirements (control strategies) for the facility was initiated to support the topical meeting agenda that is associated with Part B1 of the Contract. The culmination of this effort was a refinement of the seismic requirements, including a revision to the seismic design criteria, that were developed during Part A of the Contract. The SRD amendment was initiated to reflect these changes in seismic requirements. As part of the safety evaluation to this amendment, BNFL decided to address not only the basis for the SRD revision but to document the more significant seismic related evaluations that were performed during Part B1. This safety evaluation, either directly or by reference, describes the TWRS-P seismic design requirements that BNFL has developed.

As part of this description, the following is a chronological listing of events associated with the development of this ABAR.

- BNFL document, “TWRS-P Design Basis Earthquake-Peak Ground Acceleration (PGA), Seismic Response Spectra, and Seismic Design Approach,” was submitted to the RU on November 19, 1998. This submittal was made in preparation for the December 1998 seismic topical meeting and included the basis for the proposed values of peak ground acceleration (PGA).
- A seismic topical meeting was held between the RU and BNFL on December 15, 1998, in Richland, Washington. The meeting agenda included a discussion of the PGA proposed for the facility. The meeting minutes were issued by the RU on December 23, 1999.
- BNFL document, “TWRS-P Facility Design Basis Earthquake-Peak Ground Acceleration, Seismic Response Spectra, and Seismic Design Approach, RPT-W375-RU00002, Rev.1” was submitted to the RU on March 18, 1999. This document includes the basis for selecting 0.26g as horizontal PGA for the facility design.
- BNFL document, “Applicability of the DOE Documents to the Design of the TWRS-P Facility for NPH, RPT-W375-RU00003, Rev. 0,” was submitted to the RU on March 18, 1999. This document provides the basis for tailoring DOE-STD-1020 and deleting DOE-STD-1021 from the SRD.
- BNFL document, “Validation of the Geomatrix Hanford Seismic Hazard Report for use on the TWRS-P Project, RPT-W375-RU00004, Rev. 0” was submitted to the RU on March 18, 1999. This document describes the evaluation and validation of the Geomatrix report by BNFL.
- BNFL document, “Approach for Ensuring Compliance with the TWRS-P Project Radiation Exposure Standards Under Earthquake Conditions, PL-W375-RU00002, Rev. 0,” was submitted to the RU on March 18, 1999. This document describes the BNFL strategy for meeting TWRS-P radiation exposure limits for earthquakes larger than the design basis earthquake.
- BNFL document, “Seismic Analysis and Design Approach, RPT-W375-RU00005, Rev. B, “ was submitted to the RU on May 18, 1999. This document describes the BNFL seismic analysis and design approach.
- A pre-topical meeting was held between the RU and BNFL on June 2, 1999. The objective of the meeting was to discuss the BNFL seismic analysis and design approach. The meeting minutes were issued by the RU on June 9, 1999.
- BNFL document, “TWRS-P Facility Design Basis Earthquake-Peak Ground Acceleration, Seismic Response Spectra, and Seismic Design Approach, RPT-

W375-RU00002, Rev. 2,” was submitted to the RU on June 14, 1999. The submittal was in preparation for the June 1999 seismic topical meeting. The document includes a discussion of the basis for selecting 0.26g as the horizontal PGA.

- BNFL document, “Applicability of DOE Documents to the Design of TWRS-P Facility for NPH, RPT-W375-RU00003, Rev. 1,” was submitted to the RU on June 14, 1999. The submittal was in preparation for the June 1999 seismic topical meeting. This document incorporated RU comments into BNFL’s strategy for tailoring DOE-STD-1020 and deleting DOE-STD-1021 from the SRD.
- BNFL document, “Seismic Analysis and Design Approach, RPT-W375-RU00005, Rev. C,” was submitted to the RU on June 14, 1999. The submittal was in preparation for the June 1999 topical meeting. This document incorporated RU comments into BNFL’s seismic analysis and design approach.
- A topical meeting was held between the RU and BNFL June 22, 1999. The objective of the meeting was to discuss the BNFL seismic analysis and design approach. The meeting minutes were issued by the RU on July 7, 1999.
- RU letter (99-RU-0394) to approve the use of 0.26g as the horizontal PGA by BNFL on Hanford site was sent to BNFL on June 30, 1999.
- BNFL document, “Seismic Analysis and Design Approach, RPT-W375-RU00005, Rev. D,” was submitted to the RU on August 11, 1999. This was submitted for RU review. This document was a revision to a previous submittal to incorporate RU comments.

3. EVALUATION

The amendment involves the deletions, addition, and modifications (tailoring) of previously approved implementing standards in the SRD. The proposed amendment will:

- Replace implementing standard American Concrete Institute (ACI) 349-90 with ACI 349-97.
- Replace implementing standard ACI 349R-90 with ACI 349R-97.
- Replace implementing standard American Institute of Steel construction (AISC) N690-84 with American National Standards Institute (ANSI)/AISC N690-94.
- Replace implementing standard American Society for Civil engineers (ASCE) 4-86 with ASCE 4-98 (draft).

- Modify DOE-STD-1020 to delete references to DOE-STD-1021 and existing facilities, use more current standards for seismic design (Uniform Building Code, ASCE 4), use American Society of Mechanical Engineers (ASME) Code Case N-411 damping values for piping, adopt ANSI/AISC N690 for the design of structure steel, and ACI 349 for the design of reinforced concrete.
- Delete DOE-STD-1021.
- Replace reference to the Uniform Building Code (UBC) with reference to the 1997 UBC, the latest version.
- Replace implementing standard BNFL-5193-ISP-01, Sections 1.3.16 and 5.3 with ISO 10007, “Quality Management- Guidelines for Configuration Management.”
- Add DOE newsletter (Interim Advisory on Straight Winds and Tornadoes), dated January 22, 1998.
- Add new implementing standard ACI 530-95, “Building Code Requirements for Masonry Structures and Commentary.”

The amendment proposes to replace several existing implementing standards (ACI 349, ACI 349R, AISC N690, ASCE 4, UBC) in the SRD with new versions. The basis for the change is the new standards reflect the most current design information from the industry for seismic and other natural phenomena hazards, such as wind, flood and snow. The RU finds this acceptable.

After the ABAR was submitted, the contractor requested to replace the implementing standards ACI 318-95 and ACI 318R-95 in the SRD with more current versions of these standards, ACI 318-99 and ACI 318R-99. This request was conveyed in a written communication between RU staff and the contractor (in a fax from D. Houghton to K. Chen/L. Miller, dated October 14, 1999). Based on the rationale expressed above, the RU finds this request to update standards acceptable.

The amendment proposes to add two new standards (ACI 530-95 and DOE Newsletter “Interim Advisory on Straight Winds and Tornadoes”) to the SRD. ACI 530-95 is added because this standard will provide the contractor with most current industrial standard to design masonry structures on its facility. The DOE Newsletter is added because the description of the basic wind speeds was changed from “fastest mile” to “peak gust” with the release of the latest version, ASCE 7-95, which is used as the wind design standard in DOE-STD-1020. The DOE Newsletter provides the correct and updated standard for wind design on contractor’s facility. The RU finds this acceptable.

The amendment proposes to modify DOE-STD-1020 and delete DOE-STD-1021 from the current SRD. DOE-STD-1020 provides the contractor with NPH design and evaluation criteria for its facility. In order to apply the NPH criteria in DOE-STD-1020, each structure, system, and component (SSC) is placed in a performance category (PC).

DOE-STD-1021 provides criteria and guidance for selecting the PC of SSCs. Each SSC is categorized with more or less NPH mitigation requirements, i.e., higher or lower PC. As defined in the NPH Implementation Guide to DOE Order 420.1, performance categories range from 0 to 4 in order of increasingly stringent NPH mitigation and performance requirements and with decreasing values of annual probability of exceedance of acceptable behavior limits. The amendment lists the following major reasons for deleting DOE-STD-1021 from the current SRD:

- The contractor interpreted that DOE-STD-1021 treats workers and the public differently in the safety area, which is inconsistent with the approach contained in the SRD. The statement is based on the definition of PC-3 and PC-2 as defined in DOE-STD-1021. A PC-3 SSC is defined as the safety-class SSC, whose failure could adversely affect the environment, or safety and health of the public. A PC-2 SSC is defined as the safety-significant SSC, whose failure will adversely affect the safety of workers. The safety approach contained in the SRD states that the radiation exposure limits for both workers and the public must be satisfied with equal emphasis. The RU accepts the interpretation of DOE-STD-1021 by the contractor.
- The contractor stated that the NPH categorization process in DOE-STD-1021 is based on the assumption that identification of safety classifications of SSCs for non-NPH events is completed prior to the start of the NPH categorization process. This is stated to be inconsistent with the contractually required standards identification process of DOE/RL-96-0004, *Process for Establishing a Set of Radiological, Nuclear, and Process Safety Standards and Requirements for TWRS Privatization*. Section 3.1, paragraph (c) of DOE-STD-1021 states that its seismic design procedures assume, in general, that systematic safety and accident analysis and hazard categorization/classification for the facility under consideration have been performed. The standards identification process of DOE/RL-96-0004 states that hazards evaluation must be performed for all identified hazards at the same time whether they are NPH-related or not. The RU accepts the contractor's interpretation.
- The contractor stated that DOE-STD-1021 procedures do not match the approved SRD standards contained in Appendix A to Volume II of the SRD. The RU accepts that the procedure steps as outlined in section 3.2 of DOE-STD-1021 are not identical to those in Appendix A, and Appendix A should govern.

In lieu of the DOE-STD-1021 performance categorization methodology, the amendment proposes a new performance categorization methodology based on the definition of seismic category (SC) I, II, III and IV. The new performance categorization of SSCs is defined in the amended Safety Criteria 4.1-3 and 4.1-4. Performance Category (PC) 4 as defined in DOE-STD-1021 will be deleted. SC-I as proposed by the amendment is similar to PC-3, but more conservative, because no credit is taken for inelastic energy absorption. SC-II, SC-III, SC-IV are equivalent to PC-3, PC-2 and PC-1 respectively as defined in DOE-STD-1021. Based on DOE-STD-1021, a PC-4 SSC is defined as a SSC,

whose failure due to an NPH event would result in off-site release consequences greater than or equal to the unmitigated release associated with a large (>200 MW) category A reactor severe accident. The contractor's Initial Safety Evaluation Report (ISAR) has shown that the worst unmitigated off-site consequence for a seismic event for its facility is less than 5 Rem, which is the TWRS-P acceptable radiation exposure standard for the public as defined in Safety Criteria 2.0-1. The RU agrees with the contractor's position that on this basis, PC-4 is not likely to be applicable in TWRS-P facility. The contractor has also indicated that the identification of those SSCs, requiring additional seismic capacity beyond PC-3 requirements, will be accomplished through a seismic probabilistic risk analysis (PRA), which the contractor will use to demonstrate the compliance with the SRD radiation exposure standards (Safety Criteria 2.0-1) for earthquakes beyond the design basis earthquake (DBE). The contractor stated that the risk-based approach using the PRA results is considered preferable to the cost-based approach of seismic strengthening associated with the PC-4 designation in DOE-STD-1021. The RU finds the basis for deletion of DOE-STD-1021 and modification of DOE-STD-1020 acceptable.

In addition, the amendment also proposes other modifications in DOE-STD-1020. To be consistent with NRC acceptance criteria for seismic design, the amendment proposes to use ASME Code Case N-411 damping values for piping, ANSI/AISC N690 for the design of structure steel, and ACI 349 for the design of reinforced concrete, and replace some standards with most current versions (UBC, ASCE 4). The details are described in the submitted ABAR package. Although the contractor's seismic design is not required to be consistent with NRC acceptance criteria, it will add conservatism to its design by doing so. The RU finds acceptable the modifications in DOE-STD-1020 as proposed in the amendment.

The amendment also proposes numerous design requirement changes in the SRD. In Table 4.1 of Safety Criteria 4.1-3, 0.26g and 0.18g are selected to be horizontal and vertical peak ground acceleration (PGA) respectively for the design basis earthquake (DBE) for the Hanford site. A new response spectra curve (Figure 4-1), based on the newly selected PGA, is added to the SRD. The basis for the PGA selection was the evaluation by the contractor of Geomatrix Hanford Seismic Report ("Validation of the Geomatrix Hanford Seismic Report for Use on the TWRS-P Project", RPT-W375-RU00004, Rev.0, dated March 17, 1999). The RU has reviewed the evaluation report and approved the revised ground acceleration and response spectra in a letter (DOE RU letter 99-RU-0394, dated June 30, 1999).

In order to provide adequate safety for the public and workers, the amendment also proposes a detailed seismic analysis and design approach to withstand the effects of NPH, such as earthquake, without significant damage or loss of facility safety function ("Seismic Analysis and Design Approach," RPT-W375-RU00005, Rev. D, dated August 6, 1999). The analysis criteria include dynamic as well as static analyses. The dynamic analysis criteria cover development of design response spectra for the DBE and associated input time histories, soil-structure interaction modeling and analysis, and generation of seismic loads and in-structure response spectra. The static analysis criteria

cover computation of seismic loads using static force procedures. The design criteria discuss combination of seismic loads with other loads for the structure design, proportioning and detailing of the structures to ensure ductile behavior, evaluation of foundation stability against sliding and overturning, story drift, building separation and anchorage. The RU held two meetings with the contractor to discuss the approach (the seismic pre-topical meeting on June 2, 1999, and the seismic topical meeting on June 22, 1999). The RU has also reviewed several versions of contractor's seismic analysis and design approach document (Revisions B, C, and D of "Seismic Analysis and Design Approach," RPT-W375-RU00005). Each version was revised to incorporate review comments from the RU. The proposed approach meets the seismic design requirements of the SRD, including the tailored version of DOE-STD-1020 submitted with this ABAR. The RU finds the contractor's seismic analysis and design approach acceptable.

4. CONCLUSION

On the basis of the considerations described above, the RU has concluded that there is reasonable assurance that the health and safety of the public, the workers, and the environment will not be adversely affected by this proposed amendment. The proposed amendment complies with applicable laws, regulations, and requirements, conforms with DOE-stipulated top-level safety standards and principles, and provides adequate safety. The amendment request includes certification that the proposed revision to the SRD was derived using the RU approved process as described in DOE/RL-96-0004. Accordingly, this review concludes that the proposed amendment to the authorization basis is acceptable.